ACCELERATOR EXPERIMENT: Coherent Tune Shift at High Energy in the Booster

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The measurement of the coherent tune shift at high energy in the Booster has been done under the same operation conditions as specified in EXP-65. Only the vertical tune has been measured by kicking the beam with a notcher. Because of the kick, few percent of the beam intensity were lost. The kick was applied at t_1 = 8 msec and t_2 = 18 ms after injection. The charge was also measured a little after these times. The fractional tune is displayed vs. beam intensity in Figs. 1 and 2 for t_2 = 18 ms and in Fig. 3 for t_1 = 8 ms. The beam intensity was changed as explained in EXP-65, either by acting on S1 (Fig. 1) or on QV 25 (Figs. 2 and 3).

Table I summarizes the data. The bunching factor B has been derived by measuring the bunch length (see Figs. 4, 5 and 6). The Laslett coefficients α_M and α_E are the same as calculated in EXP-65. $\Delta\nu_{calc.}$ is the tune shift calculated according to the Laslatt formula

$$\Delta\nu = -\frac{Nr_p R}{\pi\nu\gamma}\left[(\alpha_M+\alpha_E) + \frac{\alpha_E}{B\beta^2\gamma^2}\right]$$

$\Delta\nu_{meas}$ is the measured tune shift.

There is a discrepancy between measurement and calculation of ~20% at t_1 = 8 ms and ~50% at t_2 = 18 ms. The measured shifts resulted larger than the calculated ones.

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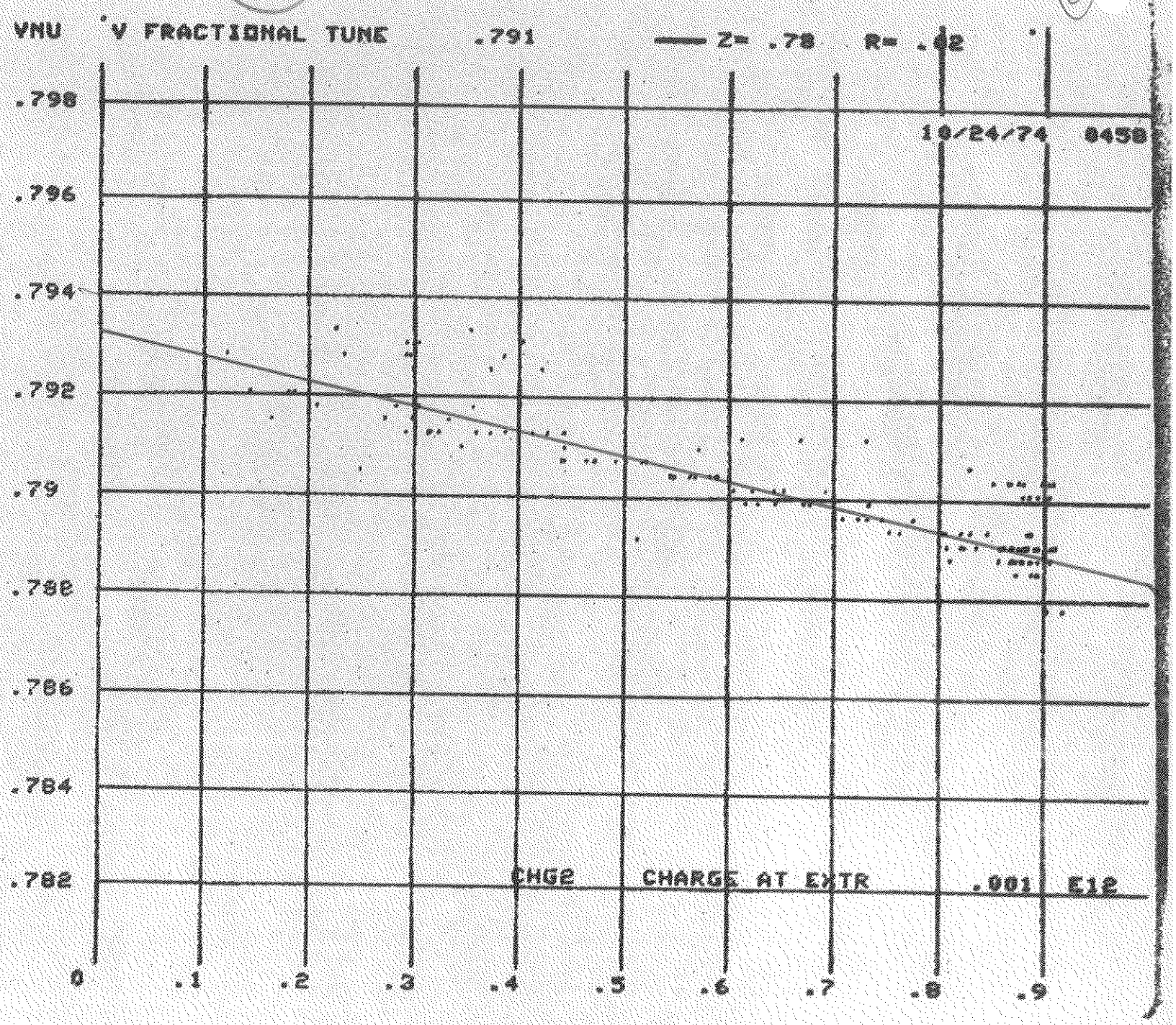
Table I

Time	8 ms		18 ms
β	0.8839		0.9843
γ	2.14		5.66
B	0.2		0.1
$B\beta^2\gamma^2$	0.716		3.10
N		1.0×10^{12}	
r_p		1.5347×10^{-18} m	
R		75.4717 m	
ν		6.8	
α_M		0.218 cm^{-2}	
α_E		0.0519 cm^{-2}	
$(\alpha_M+\alpha_E)+\frac{\alpha_E}{B\beta^2\gamma^2}$	0.342 cm^{-2}		0.287 cm^{-2}
$Nr_pR/\pi\nu\gamma$	0.0236 cm^2		0.0095 cm^2
$\Delta\nu_{calc}$	-0.0081		-0.0027
$\Delta\nu_{meas}$	-0.01		-0.005

20K

S1



$\Delta\nu = 0.005$ (across scan)

$t = 16$ ms

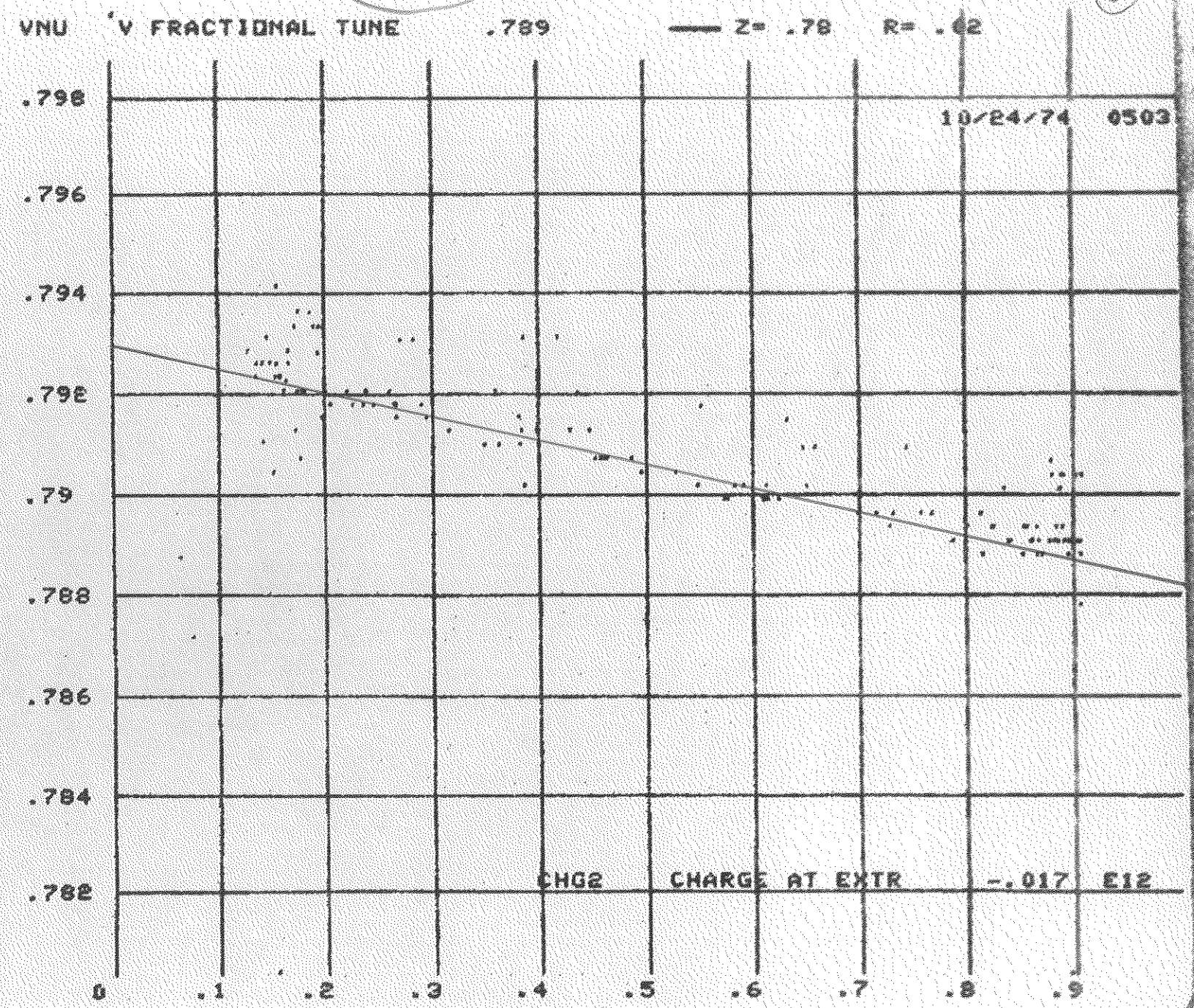
$\gamma = 5.7$

$B = 0.1$

FIG. 1

QV 25

20K



$\Delta\nu = 0.005$

(across scan)

$t = 18$ ms

$\gamma = 5.7$

$B = 0.1$

FIG. 2

QV25

10 K

B213

$\Delta\nu = 0.01$

(across scan)

$t = 8$ ms

$\gamma = 23$

$R = 0.2$

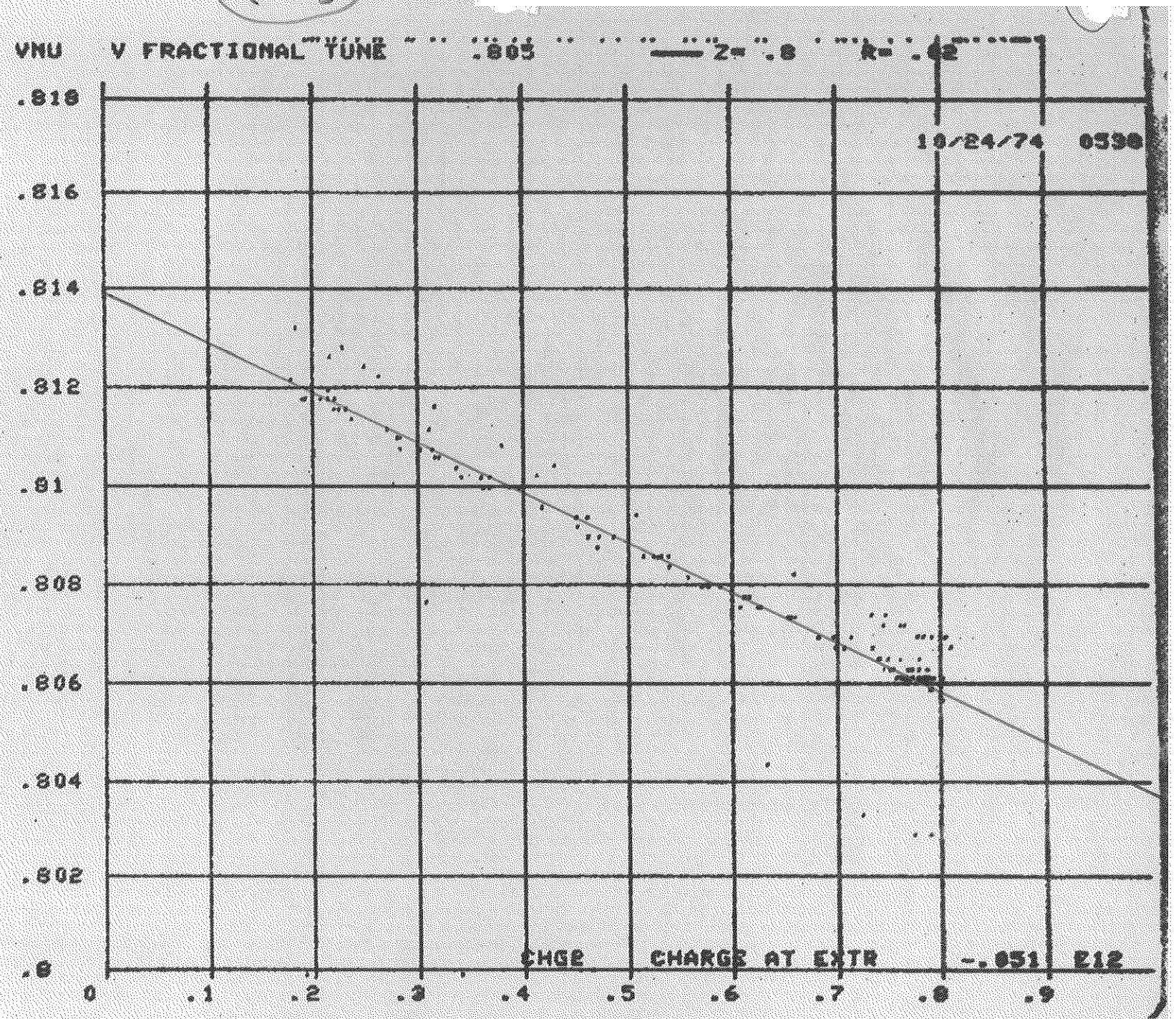


FIG. 3

L20

100 μs

$t_0 = 0.2$ ms

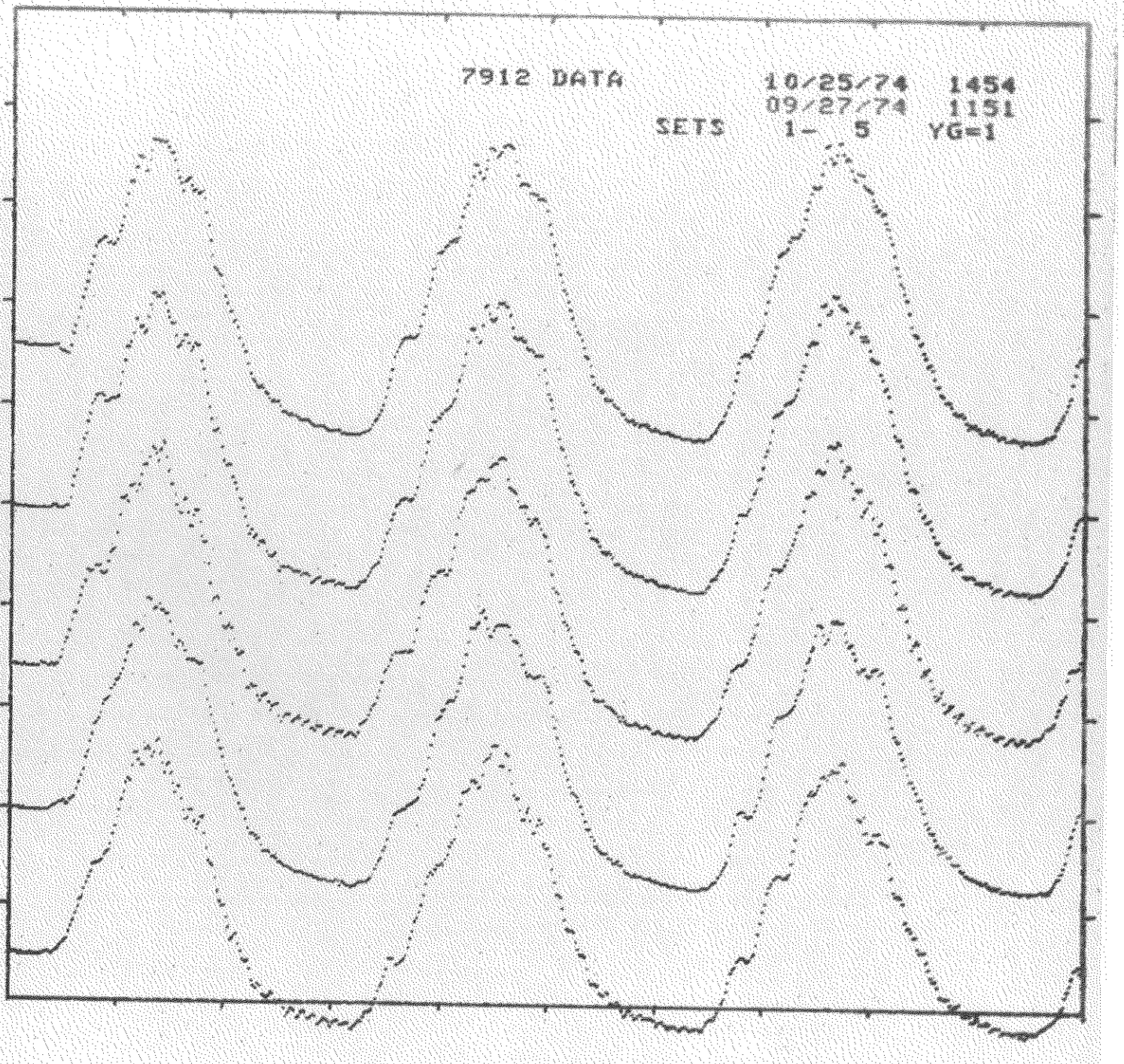


FIG. 4

10 ms
L18
10 ns/div
.2 V/div

$t_1 = 8$ ms

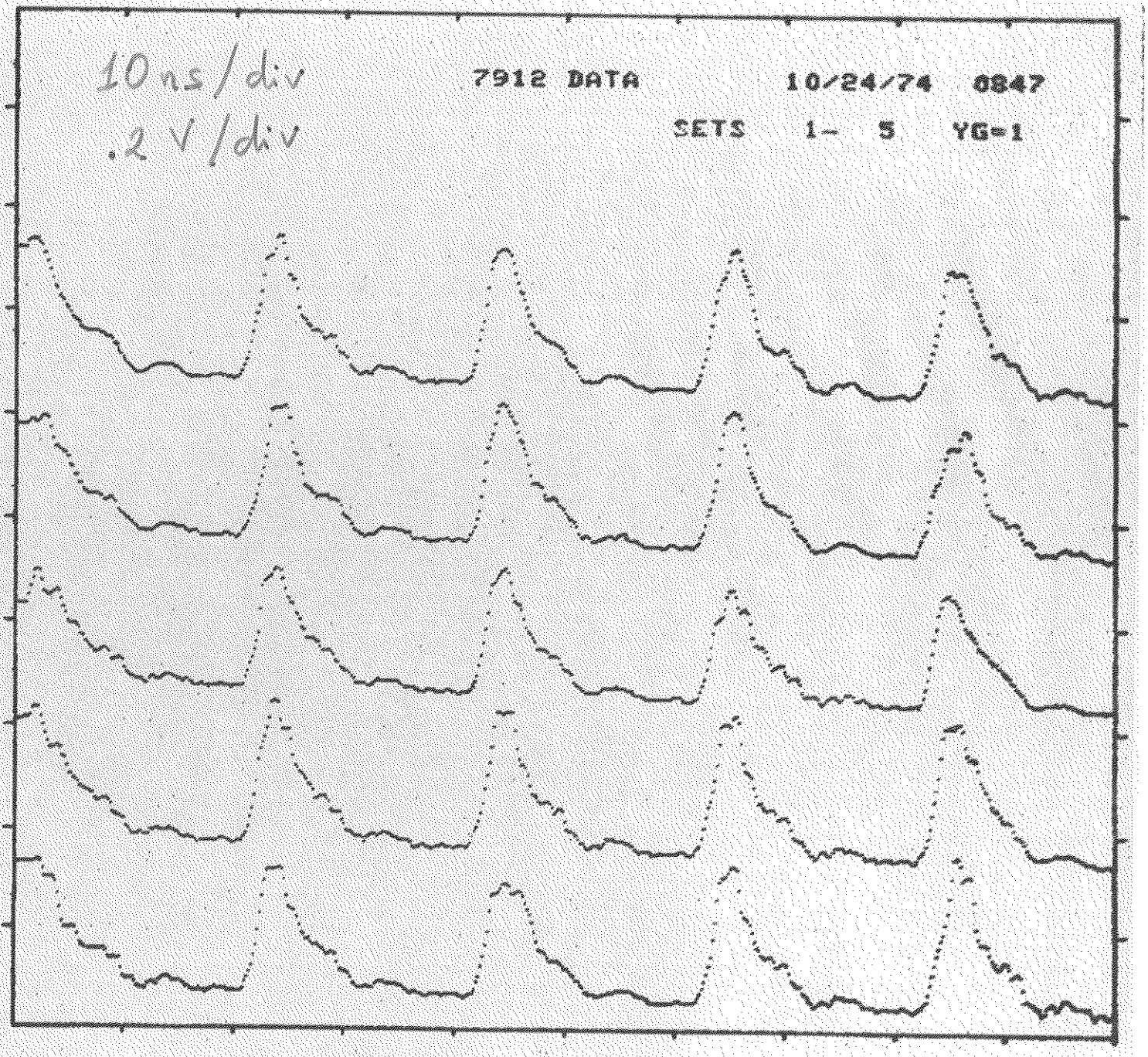


FIG. 5

20 ms
L 18
5 ns
1 V

$t_2 = 18$ ms

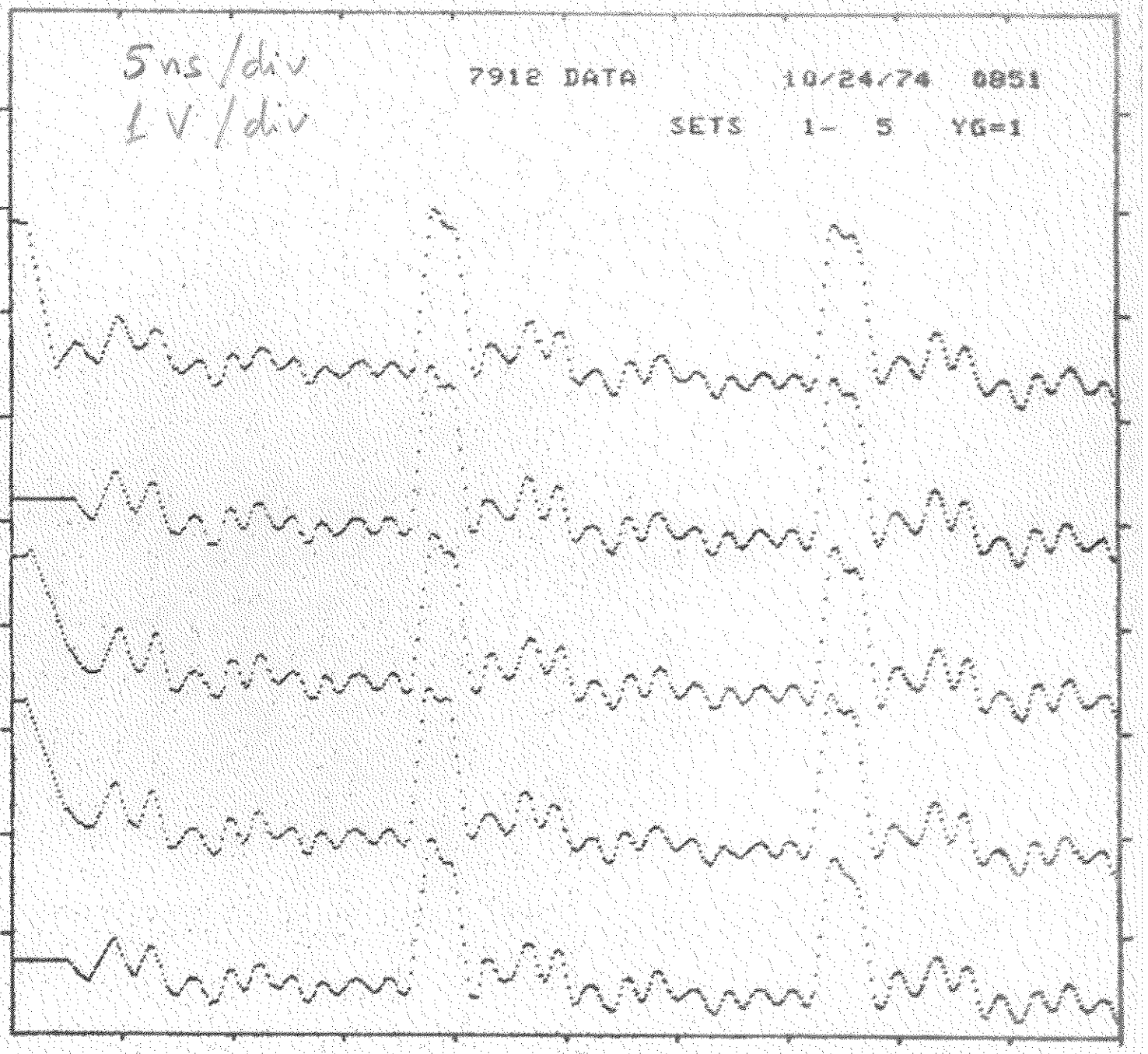


Fig. 6